

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.2 REFERENCE STANDARDS

Applicable only to the extent specified.

- A. American Society for Testing and Materials (ASTM)

- 1. B3 Standard Specification for Soft or Annealed Copper Wire.
- 2. B8 Standard Specification for concentric-lay-stranded copper conductors; hard, medium hard, or soft.
- 3. D1000 Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes used for electrical and electronic applications.

- B. Federal Aviation Administration (FAA)

- 1. C-1217f Electrical Work, Interior.
- 2. STD-019e Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities.

- C. Federal Specification (FS)

- 1. W-S-610 Splice Connectors.
- 2. QQ-W-343 Wire, Electrical, Copper, Uninsulated.

- D. National Electrical Contractors Association (NECA)

- 1. Standard of Installation.

- E. National Electrical Manufacturers Association (NEMA)

- 1. WC3 Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- 2. WC5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. WC8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

4. WC26 Wire and Cable Packaging.

F. International Electrical Testing Association (IETA)

1. ATS Acceptance Testing Specification for Electric Power Distribution Equipment and Systems

D. National Fire Protection Association (NFPA)

1. 70 National Electrical Code (NEC)

G. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.7 Description and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

H. Underwriters Laboratories (UL)

1. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 SUBMITTALS

- A. Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

1.4 QUALITY ASSURANCE

- A. Testing Firm Qualifications: An independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7, or shall be a full member company of the International Electrical Testing Association (NETA).

1. Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Comply with NFPA 70, NEC, for components and installation.

- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

- D. Installer Qualifications: Cable splices shall be performed by experienced and qualified cable splicer. The workmen shall be licensed if required by the authority having jurisdiction.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f and FAA STD-019e.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- B. Rubber Insulation: Conform to NEMA WC 3.
- C. Thermoplastic Insulation: Conform to NEMA WC 5.
- D. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG. Stranded conductors shall be tin coated, ASTM B8, Class B.
- E. All wire and conduit sizes are based on copper conductors with 75 degrees C insulation.
- F. Size: Minimum 12 AWG. Minimum 10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and 10 AWG for 277 volt circuits where circuit length (one way) exceeds 150 feet from source. Communication and control systems wiring size shall be in accordance with Manufacturer's requirements or as specified elsewhere in the specifications.
 - 1. Stranded conductors may be used with wire compression connectors or a pressure washer type lug.
 - 2. Stranded conductors smaller than 10 AWG are allowed in applications where vibration and flexing may be encountered.
- G. Conductor type: Soft drawn, annealed copper (aluminum conductors are not acceptable).
 - 1. Power conductors shall be single conductor type.
 - 2. Control interconnection between equipment shall be jacketed type multi-conductor.

3. Instrumentation conductor shall be twisted pair, shielded, jacketed type.
 4. Conductors used for lighting and receptacle branch circuits shall be single conductor type.
 - H. Conductor Color Codes: Refer to Section 16195, "Electrical Identification," for conductors No. 4 AWG and larger, where factory color coding is not available.
 1. Feeder conductors to panels and three phase circuits shall be factory color coded as follows:
 - a. 208/120 (240) Volt System
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase c: Blue
 - 4) Neutral: White
 - 5) Ground: Green
 - b. 480/277 Volt System
 - 1) Phase A: Yellow
 - 2) Phase B: Brown
 - 3) Phase C: Orange
 - 4) Neutral: Grey
 - 5) Ground: Green
 2. Single-phase branch circuits shall be factory color coded as stated above, or identified in accordance with Section 16195, "Electrical Identification."
 3. Switch leg conductors shall be violet insulated.
 4. Control Cables shall be IAW NEMA WC5.
 - I. Un-insulated conductors shall be copper and comply with F.S. QW-343.
 - J. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- 2.3 CONNECTORS AND SPLICES
- A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.
 - B. Connectors, Splice Sleeves and Terminal Lugs: Wire and cable connectors, lugs, and sleeves shall be in compliance with UL 486A, and the following:

1. For splices of 10 AWG and smaller building wires in lighting circuits, use tin plated copper compression type connector caps with nonflammable, self-extinguishing insulation grip with temperature rating equal to that of conductor insulation; and
 2. Use ring tongue compression type terminators with insulated barrel on all stranded conductors used in control wiring.
 3. Crimp type connectors not permitted on solid conductors.
- C. Insulating Tape: ASTM D1000. As a minimum, rate equal to conductor insulation. Rubber tape shall be silicon rubber with silicon pressure sensitive adhesive.
- D. Bundling Straps: Nylon straps with a locking hub or head on one end and a taper on the other.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Feeders: Type THHN/THWN, copper conductor, in raceway.
- B. Indoor Branch Circuits: Type THHN/THWN, copper conductor, 90 degree C insulation in raceway. To use in dry locations only application for lighting and receptacle circuits.
- D. Fire Alarm Power Circuits: Type THHN/THWN, copper conductor, in raceway.

3.3 INSTALLATION

- A. Materials procured and installed in this Section shall be in accordance with FAA-C-1217f and FAA STD-019e.
- B. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."
- C. Remove existing wire from raceway before pulling in new wire and cable.
- D. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.

2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
 3. Bend to radii not less than the minimum bending recommended by manufacturer or 12 times the outer diameter of cable. Do not exceed the pulling tension recommended by manufacturer.
- E. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation or damage to the outer protective covering.
- F. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- G. Conductor Splices: Keep to minimum.
1. Splices shall be made only at outlets, junction boxes, or accessible raceways.
 2. Wire nuts may only be used to splice conductors sized No. 10 AWG and smaller.
 3. Compression connectors shall be used to splice conductors No. 8 and larger.
 4. All splices, including those made with insulated wire nuts shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.
 5. Splicing of ungrounded conductors in panelboards is not permitted.
 6. Splices shall be made with solder-less connectors conforming to UL 486A, UL 486C, UL 486E and FS W-S-610.
 7. No splices shall be allowed on critical feeders. Critical circuits are identified on drawings.
 8. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 9. Use splice and tap connectors that are compatible with conductor material.
 10. Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the COR prior to installation
- I. Grounding: Materials and equipment installed at this facility shall be grounded in accordance with FAA-C-1217f.
- J. Separate neutral and ground wires shall be provided for each over current protection device. Each branch circuit shall have its own neutral and ground conductor. Common neutral or ground is not acceptable.
- K. Neutral conductors shall extend from the neutral bus where the phase conductors originate.
- L. Install electrical identification devices specified in Section 16195 "Electrical Identification", at terminations, immediately after installing wires and cables.
- 3.4 FIELD QUALITY CONTROL

- A. Testing, General: Cables shall be tested prior to installation and again upon completion of the installation. Testing shall be accomplished before connection is made. Tests shall be performed in the presence of the COR.
 - 1. Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - a. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
 - b. Test wire and cable for continuity or circuitry, and also for short circuits.
- B. Insulation Resistance Tests: Feeder and Branch Circuit insulation tests shall be performed after installation, but before connection to equipment.
 - 1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 mega ohms when measured with a 500-volt DC insulation resistance tester. The contractor shall submit a letter type test report to the COR prior to final inspection of the Work. The report shall list the tests performed and results obtained.
 - a. Apply the test voltage for at least one minute after motor reading has stabilized.
 - 2. Where new and existing cables are to be spliced, both cables shall be tested. The resistance values for new cable shall not be less than those recommended by the cable manufacturer. Resistance values for existing cable insulations shall not be less than 80 percent of the value for a comparable new cable. Report to COR, location of existing cable installation with less than 80 percent insulation value of new cable to be spliced.
- C. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

*****END OF SECTION 16120*****